FOREST PRACTICES CODE

of

BRITISH COLUMBIA

Soil Conservation Guidebook

2nd Edition
May 2001

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FOREST PRACTICES CODE

Soil Conservation Guidebook

2nd Edition
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Preface

This guidebook has been prepared to help forest resource managers plan, prescribe, and implement sound forest practices that comply with the Forest Practices Code.

Guidebooks are one of the four components of the Forest Practices Code. The others are the ***Forest Practices Code of British Columbia Act***, the **regulations**, and the **standards**. The *Forest Practices Code of British Columbia Act* is the legislative umbrella authorizing the Code's other components. It enables the Code, establishes mandatory requirements for planning and forest practices, sets enforcement and penalty provisions, and specifies administrative arrangements. The regulations lay out the forest practices that apply province-wide. Standards may be established by the chief forester, where required, to expand on a regulation. Both regulations and standards, where required and established under the Code, must be followed.

Forest Practices Code guidebooks have been developed to support the regulations, but are not part of the legislation. The recommendations in the guidebooks are not mandatory requirements, but once a recommended practice is included in a plan, prescription, or contract, it becomes legally enforceable. Guidebooks are not intended to provide a legal interpretation of the *Act* or regulations. In general, they describe procedures, practices, and results that are consistent with the legislated requirements of the Code.

The information provided in each guidebook is to help users exercise their professional judgement in developing site-specific management strategies and prescriptions to accommodate resource management objectives. Some guidebook recommendations provide a range of options or outcomes considered acceptable under varying circumstances.

Where ranges are not specified, flexibility in the application of guidebook recommendations may be required to adequately achieve land use and resource management objectives specified in higher-level plans. A recommended practice may also be modified when an alternative could provide better results for forest resource stewardship. The examples provided in many guidebooks are not intended to be definitive and should not be interpreted as the only acceptable options.

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1 Introduction

The objectives of soil conservation under the Forest Practices Code (Code) are:

- To limit the extent of soil disturbance, caused by harvesting and silviculture activities that negatively affect the physical, chemical, and biological properties of the soil.
- To conduct forest practices in a manner that addresses the inherent sensitivity of a site to soil-degrading processes to minimize detrimental soil disturbance, landslides, soil erosion, and sediment delivery to streams.
- To limit the area of productive forest land that is occupied by permanent roads, landings, pits, quarries, and trails to the minimum necessary to safely conduct forest practices.

Under the Code, disturbance is classified into two main types:

- areas occupied by permanent access structures; and
- areas occupied by soil disturbance in the net area to be reforested (NAR).

Soil disturbance in the NAR is further categorized as the area occupied by corduroyed trails, compacted areas, areas of dispersed disturbance, and unrehabilitated temporary access structures. These and other related terms are defined in the Operational Planning Regulation and the Woodlot Licence Forest Management Regulation, and discussed in some detail in this guidebook. The maximum proportion of an area that can be occupied by permanent access structures and subjected to soil disturbance must be stated in a silviculture prescription. As well, stand management prescriptions must specify the maximum amount of soil disturbance permissible as a result of mechanized stand tending treatments. Rehabilitation is required for temporary access structures and certain categories of soil disturbance, unless exempted by the district manager.

The numbered highlight boxes that appear throughout this guidebook contain descriptions of mandatory prescription and practice requirements. The specific *Act* and regulation section numbers that coincide with each highlight number are listed in Appendix 1. The *Act* and regulations should be referenced for the precise wording of these provisions.

Soil conservation requirements for woodlot licence areas may differ from those for areas covered under other forms of tenure. These are discussed in a separate section in this guidebook.

This guidebook contains recommendations on how to prepare prescriptions that specify limits for various types of soil disturbance. The purpose of such specifications is to ensure that the soil resource is adequately protected during forestry operations.

2 Permanent access structures

To facilitate forest management, part of the forest land base is permanently occupied by roads and other structures that provide access to the forest. Minimizing the amount of productive forest land occupied by these structures is an important objective of forest management.

Permanent access structures include on-block roads, landings, gravel pits, borrow pits, quarries and permanent logging trails that are reasonably required for timber harvesting and other forest management activities. To be considered permanent they must satisfy either of the following two conditions:

- they will be required for a long enough time (either continuously or periodically) such that a commercial crop of trees could not be produced on the area they occupy by the time a commercial crop is established in the adjacent cutblock area; or
- they will be constructed through soil or rock that is not suitable (or will be composed of ballast or other material that is not suitable) for necessary soil rehabilitation treatments to grow a commercial crop of trees.

Permanent logging trails include any logging trail (including an excavated or bladed trail) that is specifically identified in an approved silviculture prescription as a permanent logging trail. These trails are required for repeated stand entries to carry out periodic harvesting of areas where partial cutting silvicultural systems or commercial thinning operations are prescribed. They will not be reforested or rehabilitated. However, they must be constructed and used in a manner that minimizes soil erosion and sediment delivery to streams. They should be deactivated and left in a stable condition when not in use.

A.i) Ensure that the maximum proportion of the total area under the prescription that may be occupied by permanent access structures is recorded in the silviculture prescription.

A.ii) Ensure that the approximate locations of all permanent access structures, other than gravel or rock pits that are located more than 20 m from the top of a gully sidewall or the outer edge of a riparian management area, are shown on the silviculture prescription.

Permanent access structures may be treated (or, in the case of roads and landings, deactivated) to prevent soil erosion or reduce a slope stability hazard. Deactivation of permanent access structures is not the same as rehabilitation of temporary access structures (discussed in a later section of this guidebook). The objectives of deactivation are to leave the structure in a stable and maintenance-free condition.

There is no requirement to grow trees on areas deactivated to a temporary or semi-permanent level. Permanent deactivation requires only that trees be grown on receptive sites for purposes of controlling soil erosion. (Although the objective is not to establish a future commercial crop of trees on these areas, this may be an added benefit in some situations.) Rehabilitation, on the other hand, requires the restoration of soil productivity to facilitate the production of a future commercial crop of trees on the area that was occupied by the temporary access structure.

2.1 Recommended allowable site occupancy by permanent access structures

The proportion of the total area under the prescription (gross cutblock area) to be occupied by permanent access structures should be determined on a site-specific basis. Factors such as soil type, parent material, topography, stand type, silviculture system, harvest methods, equipment standards, management objectives, long-term access requirements, and safety and engineering standards will all affect the area to be occupied by these structures.

The proportion recorded in the prescription should be based on the maximum estimated amount of permanent access structures proposed for the cutblock. In most circumstances, permanent access structures should not occupy more than 7% of the total area under the prescription. Examples of circumstances that may warrant occupancy that exceeds 7% include small cutblocks containing main haul roads, cutblocks with a switchbacking haul road, and other cases where topography and engineering constraints limit the options for road location and development. Where the proportion specified is more than 7% of the area a rationale for the higher level of occupancy should be provided with the prescription.

When the above determinations are made, consideration should be given to measures that will minimize the loss of productive forest land without compromising safety or proper road engineering. Road and landing areas must reflect the minimum specifications necessary for safe harvesting operations.

In areas with existing road networks, the determination of how much additional access may be required should reflect a commitment to minimizing the loss of growing site, and the conversion of productive forest land to no more than 7% of a watershed or forest development planning area.

It should be recognized that safe road design may require the concentration of roads in some areas. Wherever possible, therefore, such concentration should be offset by reducing permanent access construction in other areas so that, over the larger area, soil conservation objectives are still met.

2.2 Estimating the area occupied by permanent access structures

Engineering and design specifications can be used to estimate and rationalize the area that will be occupied by the permanent access structures.

When estimating the area that will be occupied by permanent access structures the width of the structures to be used will depend on what portion of the fill slope will be available for growing a future crop of commercial trees. Widths are measured as horizontal distances taken from the top of the cutslope. The fill slope can be included as part of a permanent access structure (i.e., excluded from the NAR) for either of the following reasons:

a) the fill slope is a growing medium unfavourable for any of the tree species ecologically acceptable for the site (as described in the next section); or
b) the fill slope will be kept free of trees to provide adequate visibility for safety purposes, or to facilitate snow removal operations on roads that will be used during winter. Where the fill slope will be reforested as part of the NAR, include only the width from the top of the cutslope to the outer edge of the running surface of the road.

For roads located on gentle terrain, the area occupied by the road includes the entire width to the outside edge of the ditches on either side of the road.

Fill slope soil material that is an unfavourable growing medium should not be included in the estimate of the area occupied by permanent access structures, if during deactivation it will be pulled back onto the excavated part of the road.

When determining how much permanent access may be required within a cutblock to facilitate harvesting and forest management activities, consider the amount of access already provided by existing haul roads.

Where a cutblock will be located adjacent to an existing road but will not include the road, and the road provides some or all of the access requirements, the proportion of the cutblock area that may be occupied by permanent access structures should account for this existing access. That is, the limit should account only for the structures that will have to be constructed within the cutblock, not existing access located outside of the cutblock boundary. For example, if a cutblock boundary is located directly adjacent to, but outside of, an existing main haul road, and this provides all of the access necessary to harvest the cutblock, the maximum proportion specified in the prescription should be 0%. Where a new cutblock contains an existing road, the estimate of the proportion of the area occupied by permanent access structures must include the area of the existing road plus any additional permanent access structures proposed for the cutblock. If the existing road is a main haul road, the total area occupied by permanent access structures will likely be much higher than if all the on-block roads had been narrow spur roads only — in some circumstances this may warrant proportions that exceed 7%.

Note that for roadside harvesting operations the portion of roadside work areas located outside of the road prism should not be included in the estimate of the area occupied by permanent access structures. They are part of the NAR (see the section on "Concentrated soil disturbance within the net area to be reforested — Roadside work areas").

When carrying out field inspections to determine compliance with the maximum allowable proportion of permanent access structures, use the assessment and survey procedures contained in the *Soil Conservation Survey Guidebook*.

2.3 Fillslope soil material

When estimating PAS occupancy for prescription purposes or for compliance assessments, the fill slope growing medium should be evaluated to determine whether or not the fill slope should be included in the road width estimate. If fill slopes are to be part of the NAR, it should be reasonable to expect that seedlings will grow on these areas at a comparable rate to seedlings growing on adjacent undisturbed areas.

Unfavourable growing media

Unfavourable fill slope soils can present physical, chemical, and/or nutrient limitations to seedling growth. The following types of fill slope materials commonly do not support seedling growth comparable to that of seedlings on undisturbed areas, and can reasonably be considered as unfavourable growing media:

- broken rock, rubbly talus, or rubbly colluvial deposits greater than 20 cm deep;
- unfavourable subsoil materials greater than 20 cm deep, such as dense, unstructured materials, calcareous or saline soils, and sands and loamy sands on some Interior sites in very dry biogeoclimatic zones;
- soil material that has been subjected to intense heat during the burning of roadside accumulations of woody debris (these soils often take on a red colour and lose their original structure); and
- fill slopes with a greater than 70% slope gradient, or with other evidence of instability, where chronic soil erosion, dry ravelling, or slumping is likely, making it difficult for seedlings to regenerate adequately.

Fill slopes of any of these materials should be included in the estimate of the total proportion of the area occupied by permanent access structures, unless local experience confirms that these sidecast materials will support adequate seedling growth.

For further information on classifying favourable or unfavourable soil materials, refer to the *Soil Conservation Survey Guidebook* or any regional or district guidelines, or consult with one of the Ministry of Forests regional soil specialists.

3 Temporary access structures

Those on-block access structures that do not satisfy the criteria for being classified as permanent access structures are considered temporary. Temporary access structures are required only for a limited period during a specific forest management phase. The area they occupy is part of the NAR, and must be suitable for rehabilitation to enable the establishment of a commercial crop of trees.

Temporary access structures include:

- excavated or bladed trails,
- main skid trails, backspar trails, corduroyed trails, and other similar structures identified as temporary access structures in a silviculture prescription, and
- roads, landings, gravel pits, or quarries identified as temporary access structures in a silviculture prescription.

B. Ensure that:

i) the approximate locations of temporary roads and landings are shown in a silviculture prescription;

ii) the approximate locations of temporary gravel or rock pits are shown in a silviculture prescription, if they will be located within 20 m of the top of a gully sidewall or the outer edge of a riparian management area;

iii) the silviculture prescription identifies those portions of a cutblock (e.g., the specific standards unit) where excavated or bladed trails are proposed for construction;

iv) the silviculture prescription specifies the maximum time to complete rehabilitation treatments of temporary access structures once harvesting operations are over; and

v) temporary access structures are rehabilitated in accordance with the Timber Harvesting Practices Regulation,[1] unless rehabilitation has been exempted by the district manager for the reasons described in the *Forest Practices Code of British Columbia Act*.

The amount and types of proposed temporary access structures should be the minimum required for a safe and efficient operation. The maximum allowable level of soil disturbance specified in a prescription must accommodate the total proportion of the NAR that will be occupied by proposed temporary access structures plus any other types of soil disturbance anticipated for the NAR. However, there are provisions to allow soil disturbance limits to be exceeded in some circumstances, as described in the section "Temporarily exceeding the maximum allowable level of soil disturbance in the net area to be reforested."

[1] At the time of publication, an amendment to the regulation was pending.

Given the expense and potential difficulties associated with rehabilitating roads and landings to a productive state, it is preferable to minimize the area occupied by these structures.

Construction of temporary access structures should be proposed only where it has been determined that rehabilitation measures can be implemented to prevent soil erosion, avoid changes in drainage patterns, and restore soil productivity. For areas where ground-based harvesting is being proposed, the sensitivity of the soil to disturbance must be assessed using procedures described in the *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook*. Based on these assessments, a determination can be made as to whether site conditions will be suitable for conducting effective soil rehabilitation treatments.

Building temporary access structures in a manner designed to facilitate subsequent rehabilitation will increase the likelihood of the soil being restored to an acceptable level of productivity. The following are examples of construction techniques that can facilitate rehabilitation of temporary structures (other recommended treatments are presented in the *Soil Rehabilitation Guidebook*):

- Where feasible, restrict the excavation depth to ensure that sidecast soil material in fill slopes is primarily productive topsoil, and to minimize effects on slope hydrology.
- Construct rolling grades or outsloped sections to reduce the distance that surface water can flow down the running surface of the trail.
- Where it is necessary to remove topsoil from the surface of a temporary landing or road, stockpile the topsoil so that it can be respread over the disturbed area, helping to restore soil productivity.
- Place woody debris against downhill stumps immediately adjacent to the site, in a cross-slope position. This prevents excavated topsoil material from ravelling down steep slopes, and makes it easier to retrieve for recontouring or respreading during rehabilitation.
- Undertake drainage control measures to prevent soil erosion during and after construction, and until rehabilitation has been completed.
- Construct excavated or bladed trails with an excavator so that excavated soil material can be placed in a position where it can be retrieved for recontouring the slope.

C. Ensure that the prescription identifies the type of equipment used for excavated or bladed trail construction, if other than an excavator.

For many of the treatments noted above, a small excavator will generally be more successful than a crawler tractor. For this reason, when crawler tractors are specified in a prescription as the trail builder, special attention should be given when supervising and inspecting the construction and subsequent rehabilitation of these trails to ensure satisfactory results. This will be particularly critical if unfavourable subsoils will be excavated during construction.

In addition to requiring rehabilitation of roads that are temporary access structures, road deactivation will also be necessary. Rehabilitation is usually done concurrently with or soon after road deactivation. The primary objectives of deactivation are to stabilize the road prism and restore natural drainage patterns. The main purpose of rehabilitation is to restore long-term productivity so that a commercial crop of trees can be established. While the two have different objectives, they sometimes involve similar activities. There is a need to coordinate the two operations and be aware of the requirements of both. Deactivation of the road must be in accordance with a deactivation prescription prepared by the holder of the permit. Rehabilitation of the road must be in accordance with any requirements of the regulations.[2]

Excavated or bladed trails

An excavated or bladed trail is a constructed trail that has an excavated or bladed width greater than 1.5 m, and a cutbank height greater than 30 cm in mineral soil. The depth of cut into the mineral soil for these trails should typically not exceed 1 m (although there may be situations — for example, in hummocky terrain — where short sections of trail may have a greater depth of cut).

D. Ensure that both the average and maximum allowable depth of cut for excavated or bladed trails are specified in a silviculture prescription.

Where an unfavourable growing medium occurs less than 70 cm below the soil surface, the maximum depth of cut into the mineral soil should result in no more than 30% of the excavated material consisting of unfavourable subsoil. This will ensure that the retrievable fill slope soil material consists mainly of productive topsoil.

E. Ensure that excavated or bladed trails are rehabilitated in accordance with the Timber Harvesting Practices Regulation,[3] unless exempted from rehabilitation by the district manager.

A situation that could be considered for an exemption from rehabilitation is where occasional blading of logging trails has resulted in short isolated portions of what would be considered excavated or bladed trails. If these excavated portions are stable, if they will not increase the risk of sediment delivery to streams, and if they account for only a small portion of the total NAR, rehabilitation may not be necessary. Ultimately, it is up to the district manager to determine whether an exemption is warranted.

[2] At the time of publication, an amendment to the Timber Harvesting Practices Regulation was pending.

[3] At the time of publication, an amendment to the regulation was pending.

Any area occupied by unrehabilitated trails must be included in the assessment of area occupied by soil disturbance, whether exempted from rehabilitation or not.

Construction of excavated or bladed trails is prohibited on sensitive soils within community watersheds, as well as on sites assessed as having a high likelihood of landslides, and in some cases sites with a moderate likelihood of landslides.

F. Ensure that the silviculture prescription complies with the Timber Harvesting Practices Regulation regarding the prohibitions against constructing excavated or bladed trails.

4 Permanent vs. temporary: classifying access structures

The determination of whether an access structure should be classed as permanent or temporary is often contingent on: a) whether the structure is suitable for rehabilitation treatments, given the type of material through or with which it is constructed, and b) the period of time for which the structure will be required for forest management activities following harvesting.

The suitability of component materials for rehabilitation depends on such factors as: use of ballast, depth of excavation into unfavourable subsoil, soil texture, opportunities for stockpiling and retrieving topsoil, and amount of coarse fragments in the soil. For example, on many coastal sites where rock work or ballasting is commonplace during road and landing construction, the large component of rock in the road or the depth of subgrade ballast used may make it unsuitable for rehabilitation. In the northeast of the province, the rehabilitation of roads constructed on very fine-textured soils may not be practical, given the high costs of treatments that would be necessary to restore soil productivity.

Guidelines may be established by regional or district staff to help identify which site and soil conditions are suitable for rehabilitation treatments.

If a road is not required for too long a period following harvesting, such that a crop of merchantable trees could be established on it by the time the adjacent cutblock area was ready for the next harvest, the road should be considered for rehabilitation.

For example, consider a spur road that is likely to be used to provide access for silviculture treatments for a 10-year period following harvesting. If the next harvest were to occur when the trees on the cutblock were 120 years old, the trees planted on the area of the rehabilitated road would be 110 years old. It is reasonable to assume that the trees on the former road would be of a merchantable size, and therefore could be harvested concurrently with the rest of the cutblock. In this case, the road *would* be proposed as a temporary access structure. Of course, to avoid a delay in regenerating the area occupied by the temporary road, it may be more beneficial to rehabilitate the road sooner, enabling it to be planted concurrently with the rest of the cutblock. Access to carry out the silviculture measures could be gained through an alternative means, if necessary (e.g., by a permanent road running through or adjacent to the cutblock, or through use of ATVs).

The on-block portions of main haul roads and branch roads (i.e., roads that pass through a cutblock to access other existing or planned cutblocks, or other forest management sites such as stand management areas or recreation sites) should be identified as permanent access roads.

On-block spur roads (i.e., those that end within a cutblock) should be considered temporary access structures, unless

- the materials used in the road construction make it unsuitable for rehabilitation, or
- future road use will preclude the establishment of a commercial crop of trees within the next rotation. This could occur for any of the following reasons:
  - there are future plans or reasonable expectations that extending the spur road will be necessary to access adjacent areas for harvesting or stand management treatments,
  - the road will be required to facilitate a multiple-entry partial cutting silviculture system within the cutblock.
  - it is reasonable to conclude that the spur road will be required after harvesting to allow forest management treatments on the cutblock for a long enough period such that a commercial crop of trees will not have sufficient time to become established (i.e., on the road area by the time of the next harvest). For this to apply it should be demonstrated that the spur road is actually necessary for access. In many situations road access to the cutblock boundary or by a mainline or branch road that passes through the cutblock is sufficient for allowing most post-harvesting forest management activities (an exception may be on very large cutblocks). ATVs are another means of providing access, and may warrant including allowances in the silviculture prescription to enable narrow access trails to be used on rehabilitated roadways.

Most gravel pits and borrow pits are likely to be permanent due to the inherent difficulty in restoring site productivity on these excavated structures.

Excavated or bladed trails are temporary access structures, unless they are required to be retained as permanent logging trails (e.g., to facilitate multiple entries in partial cutting operations). Non-excavated logging trails (e.g., main skid trails) may be identified on a silviculture prescription as temporary access structures. This will most often occur in situations where use of these trails could result in prescribed maximum soil disturbance limits being exceeded prior to their planned rehabilitation. For more details, see the section, "Temporarily exceeding the maximum allowable level of soil disturbance in the net area to be reforested." If construction of a proposed backspar trail is likely to result in soil disturbance that satisfies the definition for an excavated or bladed trail, the backspar trail should be designated as a temporary access structure. Otherwise, the presence of an excavated or bladed trail would have to be specifically accounted for in the silviculture prescription.

5 Soil disturbance in the net area to be reforested (NAR)

G. Ensure that the maximum proportion of the NAR that may be occupied by soil disturbance is specified in the silviculture prescription.

An objective of placing limits on the amount of soil disturbance allowed within the NAR is to ensure that site productivity is maintained and that impacts to other resource values are prevented or mitigated. Harvesting and silviculture activities must be carried out such that the total amount of soil disturbance at any time during operations does not exceed the specified maximum. An exception is when the silviculture prescription specifies the extent to which maximum soil disturbance limits may be temporarily exceeded to construct temporary access structures (see the section "Temporarily exceeding the maximum allowable level of soil disturbance in the net area to be reforested").

Soil disturbance types and related categories are defined in both the Operational Planning Regulation and the Woodlot Licence Forest Management Regulation. Soil disturbance is a general term referring to the following:

- temporary access structures, including excavated or bladed trails of a temporary nature
- corduroyed trails
- compacted areas
- dispersed disturbance

Corduroyed trails are constructed using logs and woody debris placed side by side to form a running surface at least 2 m in length capable of supporting machine traffic. These trails must be rehabilitated unless exempted by the district manager.

Compacted areas show evidence of compaction over extensive areas, greater than 100 m^2 , and are at least 5 m wide. These areas must be rehabilitated unless exempted by the district manager.

Dispersed disturbance is itself a general term referring to dispersed trails, gouges, and scalps. Dispersed trails include rutted trails (created by ground-based equipment operating on sites when the soil has limited load-bearing strength) and trails showing evidence of compaction caused by repeated machine traffic. Gouges are subdivided into deep gouges, wide gouges, and long gouges. Scalps are divided into wide scalps and very wide scalps. These terms are defined largely by minimum size criteria (e.g., depth into mineral soil, length and width of an area where forest floor or mineral soil has been removed). Some of these categories, such as wide scalps, count as soil disturbance only on more sensitive sites (e.g., wide scalps are tallied only if they occur on sites with "very high" hazard ratings). Definitions of soil disturbance

categories are provided in the Operational Planning Regulation. The *Soil Conservation Survey Guidebook* should be consulted for more detailed descriptions.

5.1 Recommended allowable soil disturbance within the net area to reforested (NAR)

Coastal sites

Soil disturbances of the types and dimensions described in the regulations should not occupy more than 5% of any portion of the NAR for the area under a silviculture prescription.

The actual proportion of the NAR that may be occupied by soil disturbance must be determined for each site and specified in the silviculture prescription. Where it can be demonstrated that similar sites have been harvested and treated with less than 5% of the NAR being occupied by soil disturbance, the lesser amount should be recorded in the silviculture prescription. For example, if an area would normally be harvested with a skyline system and soil disturbance would generally occupy less than 1% of the NAR, this lower amount should be specified in the silviculture prescription.

Interior sites

Before standards units for silviculture prescriptions are delineated, site and soil data must be collected to characterize variability in site sensitivity. The subsequent evaluation of mineral soil sensitivity involves working through hazard assessment keys for soil compaction and puddling, soil displacement, and soil erosion. All three soil disturbance hazards must be considered in the development of a silviculture prescription. However, the *most restricting* soil disturbance hazard identified within the area to be harvested should be the primary one considered when the proportion of the NAR that may be occupied by soil disturbance is being prescribed. (Refer to the *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook* for procedures for determining hazard ratings.) Table 1 provides recommendations on the maximum proportion of the NAR within any standards unit that may be occupied by soil disturbance based on hazard ratings.

The actual proportion of the NAR that may be occupied by soil disturbance must be determined for each standards unit and specified in the silviculture prescription. For areas where cable or aerial harvesting is proposed and soil hazards are not assessed, soil disturbance should not occupy more than 5% of the NAR.

Where soil sensitivity to disturbance varies significantly, the NAR should be stratified into homogenous standards units with separate limits established for each. Where the assessed soil sensitivity to disturbance varies significantly within any portion of the NAR and it is not possible to establish separate homogeneous strata, the most restrictive hazard should be used to determine the sensitivity for that area. This conservative approach will minimize the risk of harvest operations or silvicultural treatments that cause excessive or concentrated soil disturbance in the more sensitive areas.

Table 1. Recommended allowable soil disturbance within the net area to be reforested (NAR) of Interior sites

Leading soil disturbance hazard[a]	Soil sensitivity rating[b]	Allowable soil disturbance (% NAR)
Soil erosion	VH	5
Soil displacement	VH	5
Soil compaction	VH	5
Soil erosion	H, M, L	10
Soil displacement	H, M, L	10
Soil compaction	H, M, L	10

[a] For definitions of hazard types and the procedures for determining hazard ratings, refer to the *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook*.

[b] VH = Very High; H = High; M = Moderate; L = Low

5.2 Forest practices that may warrant higher levels of allowable soil disturbance

The district manager may consider approving a greater amount of soil disturbance than the recommended maximum allowable limits if:

- that disturbance is unavoidable in the process of achieving other significant management objectives; and
- the proposed activities (responsible for the greater soil disturbance) will not cause or increase the risk of damage to other resource values.

Following are six examples of forest practices that may be required to achieve free-growing stocking on some sites. These practices would likely result in soil disturbance occupying more than the recommended maximum proportion of the NAR, and may warrant the approval of silviculture prescriptions that specify higher soil disturbance limits.

- Salvaging windthrown timber may result in soil disturbance that exceeds the maximum recommended disturbance. Where feasible, rehabilitation measures should be implemented to reduce the total soil disturbance. Soil disturbance caused by a windthrow event should not be included in the assessment of total disturbance. The objective is to minimize subsequent harvesting-related soil disturbance.

- Push-over harvesting or post-harvest stump excavations may be required to control the spread of root diseases. Where these treatments are anticipated to cause excessive soil disturbance, rehabilitation and mitigative measures should be implemented to reduce the soil disturbance as close to the recommended maximum allowed as is practicable. Push-over harvesting or post-harvest stump excavation operations should not be conducted on sensitive soils.

- Producing very large mounds to create elevated planting sites has been successfully used to reforest wet sites on the Queen Charlotte Islands. In most cases, such mounding can be conducted within the soil disturbance limit specified for the Coast. However, where the prescribed number of mounds per hectare is greater than 500, approval to create greater soil disturbance may be required.

- For vegetation control to be achieved in salal-dominated ecosystems, or on areas where thick forest floor development impedes seedling establishment and growth in wetter coastal biogeoclimatic units, higher levels of soil disturbance may be necessary. In such cases, forest floor removal may be required over large areas, the dimensions of which would count as wide scalps on sensitive sites and thus contribute to the total area of soil disturbance.

- Site preparation treatments on backlog reforestation areas often include some extensive scalping of the soil to control competing vegetation that may prevent the regeneration of conifer crops. Where these sites have deep, fertile soils, localized scalping may be acceptable.

- Site preparation treatments for the establishment of broadleaf species such as hybrid poplars may involve extensive scalping to control weed growth, and stump removal and other clearing operations to facilitate cultivation. Such treatments may require approval to create greater soil disturbance, especially on sensitive sites where wide scalps would count towards disturbance.

6 Temporarily exceeding the maximum allowable level of soil disturbance in the net area to be reforested (NAR)

H. The maximum limit for soil disturbance in the NAR can be temporarily exceeded to construct temporary access structures, as long as:
- the maximum extent of this additional disturbance is specified in the silviculture prescription;
- the temporary access structures are identified in the prescription; and
- the prescription specifies the maximum time required to complete the rehabilitation of (all) these temporary access structures.

Allowing maximum soil disturbance limits to be temporarily exceeded can provide operators with more latitude in selecting cost-efficient harvesting methods and techniques. For example, consider a prescription that specifies a 5% maximum allowable soil disturbance: the normal choice of harvesting system would be a cable system; however, if an additional 5% of the NAR could be (temporarily) occupied by excavated or bladed trails (i.e., for a combined total of 10% soil disturbance before rehabilitation), a ground skidding system may be a practical and less costly option.

Total harvesting costs may be reduced by constructing and subsequently rehabilitating temporary roads or temporary landings that would otherwise be considered in excess of the minimum required to harvest the cutblock. The additional area to be temporarily occupied by these structures (i.e., the area that will exceed the specified maximum allowable level of soil disturbance) must be recorded in the prescription as a proportion of the NAR.

The extent of this additional soil disturbance should not exceed 5% of the NAR.

These temporary access structures should be planned only where adequate conservation of soil resources and protection of other resource values can be achieved. These structures must be rehabilitated following harvesting, and must be constructed on sites amenable to, and in a manner conducive to, successful rehabilitation.

7 Concentrated soil disturbance within the net area to be reforested (NAR)

Soil disturbance has the least potential to reduce soil productivity if it is dispersed. Harvesting or silviculture operations should be planned and conducted to avoid creating areas of concentrated soil disturbance in localized areas. Generally, the amount of soil disturbance within any contiguous area greater than 1 ha (i.e., away from roads, landings, and main trail junctions) should not exceed the level of soil disturbance specified for the standards unit within which it occurs.

Sensitive soil areas (e.g., areas of saturated soils) not identified during the pre-harvest data collection phase should be avoided by ground-based harvesting, mechanical site preparation, and mechanical stand tending equipment. As well, the creation of closely spaced ruts through sensitive soil areas should be avoided during harvesting operations.

It is important to note that, in some situations, such as partial cutting operations, using dispersed or random skidding may have unacceptable impacts on soil productivity. For example, with multiple-entry partial cutting silvicultural systems, dispersed skidding may result in additional amounts of soil disturbance with each successive entry. The result might be that, by the time the entire cutblock is harvested, the cumulative soil disturbance could far exceed the recommended maximums. Measures such as limiting machine travel to a designated skid trail network or conducting operations on frozen ground or deep snowpacks should be used to limit the cumulative effects of ground-based harvesting in these partial cutting operations.

7.1 Critical site conditions

I. Ensure that critical site conditions (including sensitive soils) that affect the timing of operations are described in the silviculture prescription, along with a description of how these conditions affect such timing.

All sites can experience excessive soil disturbance when soils are wet enough, and therefore due diligence is required to avoid these impacts. However, there are some areas that are more sensitive to machine impacts, and may have a much narrower range of operating conditions than most sites due to local site and soil characteristics. For instance, sites with finer-textured soils, such as those with high and very high compaction hazards, are most likely to hold moisture and remain wet for longer periods during which they are most susceptible to compaction and structural degradation from puddling. Similarly, minor depressions and shallow draws will hold moisture and remain wet for long periods, making them susceptible to excessive

disturbance, even when most of the cutblock may be dry enough to operate on. These are examples of critical site conditions that may warrant special consideration when planning and implementing operations.

For those areas identified as having critical site conditions, timing of operations in relation to the soil moisture condition is a key management consideration. To reduce the likelihood of excessive soil disturbance, it is often necessary to limit ground-based harvesting and mechanical site preparation to periods when specific site or soil disturbance is evident (e.g., when soils are sufficiently dry or frozen, or are protected by an adequate snowpack). Local experience or regional guidelines may help in determining when conditions are suitable. Where it is not clear what would constitute "sufficient" or "adequate" conditions, it may be more appropriate to describe the type of impacts that the operator is to avoid. For example, on a site with a very high soil compaction hazard, a silviculture prescription could include a statement that says "operate only during periods when the soil is sufficiently dry to prevent perceptible ruts." Such information can be used to monitor operations to ensure that site conditions remain acceptable for equipment to operate on.

7.2 Roadside work areas

Roadside work areas within the NAR are located adjacent to haul roads and are used during roadside harvesting operations for such activities as decking, processing, loading, and debris piling and disposal. Roadside work areas can be subject to concentrated and high levels of soil disturbance compared to other areas within the NAR. The width of a roadside work area will vary depending on a number of factors including: the length of trees or logs forwarded to the roadside; and whether processing, loading, or debris disposal is carried out by equipment operating from the roadway or whether the equipment performing these tasks operates adjacent to the road within the NAR. To minimize the area occupied by roadside work areas and to reduce soil disturbance levels, the roadway should be used as much as possible to carry out harvesting activities (e.g., by keeping the loader and excavator on the road while logs are being loaded and debris is being piled). This practice is particularly important when operating on small or narrow cutblocks where roadside work areas may otherwise occupy a disproportionately large amount of the NAR.

J. Do not allow the maximum level of soil disturbance to exceed 25% of the area that is both within the net area to be reforested and used to carry out roadside work activities.[4]

[4] The requirement of the Timber Harvesting Practices Regulation came into effect on June 15, 1998 and applies despite any limit specified in the silviculture prescription for the standards unit that contains the roadside work area.

The roadside work area should be shown as a separate standards unit from adjacent areas in the cutblock. This is especially important if higher levels of soil disturbance are likely to occur within the roadside work area, which may require implementation of silviculture treatments or stocking levels that are different from those of adjacent areas.

K. Do not operate ground-based equipment on roadside work areas for debris piling during periods when there is insufficient soil strength to prevent concentrated disturbance, which could result in the 25% maximum soil disturbance limit being exceeded.

In some situations, logging has occurred under favourable soil conditions (e.g., on dry or frozen soils); however, during the subsequent phase of debris piling, less attention has been paid to the condition of the soil and the potential impacts from ground-based equipment. Piling operations on roadside work areas during unfavourable soil conditions (e.g., when soils are wet) have resulted in excessive levels of soil disturbance. When soil conditions are unfavourable, using an excavator rather than a crawler-tractor to pile debris should result in considerably less disturbance.

8 Stand management prescriptions

L. If mechanized stand tending treatments are proposed, ensure that the maximum proportion of each treatment unit that can be occupied by soil disturbance (caused by the treatments) is specified in the stand management prescription.

Determining the level of allowable soil disturbance requires first assessing the disturbance already created by previous harvesting and silviculture operations. The maximum allowable amount of soil disturbance specified should not be greater than that recommended for the Coast or Interior, as described in previous sections of this guidebook.

Where there is a significant amount of soil disturbance from previous forest practices, the acceptability of more disturbance from proposed stand tending treatments should be assessed. Measures should be implemented to limit additional disturbance as much as possible. This may involve, for example, using existing trails only and conducting operations on frozen ground or on a sufficient snowpack. Failure to consider the effect of previous activities on the soil or to implement mitigative measures may result in a cumulative soil disturbance much greater than the disturbance levels recommended for the Coast or the Interior.

Opportunities for the rehabilitation of previous disturbance should also be considered.

9 Woodlot licence area requirements

Requirements related to soil conservation on areas under woodlot licences are provided in the Woodlot Licence Forest Management Regulation (WLFMR), which became effective on November 30, 1998. Some of these requirements differ from those contained elsewhere in this guidebook (i.e., for other forms of tenure) and are discussed below.

For woodlot licence areas, a permanent access structure is any in-block road, landing, pit, or quarry except those access structures identified as requiring rehabilitation in an operational plan. Excavated or bladed trails, other logging trails, and similar structures may also be permanent access structures if identified as such in an operational plan.

M. The maximum proportion of the total area within a cutblock that may be occupied by permanent access structures is the amount specified in an operational plan, or 7% if there is no amount specified.

Those structures not identified as permanent access structures and not to be rehabilitated contribute to the total area occupied by soil disturbance.

N. The maximum proportion of any standards unit within the NAR that may be occupied by soil disturbance is the amount specified in an operational plan for the area (i.e., the forest development plan, site plan, or silviculture prescription). If an operational plan for the area does not specify the maximum proportion of the NAR that may be occupied by soil disturbance, then the limit is 5%.

For areas covered by site plans, the maximum limit for soil disturbance must accommodate the area that will be occupied by all non-permanent access structures (note that the term "temporary access structure" is not used, nor defined, in the WLFMR). Even after these structures are rehabilitated, they may still represent an area of soil disturbance if they meet the criteria for any of the categories of soil disturbance. For example, the surface of a rehabilitated temporary road that does not have any forest floor remaining could be categorized as a scalp and therefore count as soil disturbance (this would not count on an area covered by a prescription held by a major licensee or a timber sale licensee).

For areas covered by silviculture prescriptions approved before the WLFMR came into effect, access structures identified in a silviculture prescription as requiring rehabilitation do not count as soil disturbance if they are satisfactorily rehabilitated.

O. For an area under a stand management prescription that calls for mechanized ground-based stand tending treatments using heavy machinery, the maximum proportion of the treated area that may be occupied by soil disturbance is the amount specified in the prescription, or 5% if no amount is specified.

10 Additional references

For additional information and guidance related to soil conservation under the Forest Practices Code, the following materials should be consulted:

Silviculture Prescription Guidebook

Soil Conservation Survey Guidebook

Soil Rehabilitation Guidebook

Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook

Silviculture Prescription Data Collection Field Handbook: Interpretive Guide for Data Collection, Site Stratification, and Sensitivity Evaluation for Silviculture Prescriptions. Land Management Handbook 47.

Appendix 1 - *Act* and regulation section cross-references

Highlight box number	*Act* and regulation section references
A. i)	OPR 39(3)(h)
ii)	OPR 39(4)(a)(x), (xi)
B. i)	OPR 39(4)(a)(xii)
ii)	OPR 39(4)(a)(xi)
iii)	OPR 39(3)(k)(j)
iv)	OPR 39(3)(l)
v)	*Act* 47(6), 49; THPR 14, 17
C.	OPR 39(3)(k)(iii)
D.	OPR 39(3)(k)(ii)
E.	*Act* 47(7), 49; THPR 14
F.	OPR 38(c)
G.	OPR 39(3)(i)
H.	OPR 39(3)(j); *Act* 47(2)
I.	OPR 39(3)(e)
J.	THPR 18
K.	THPR 19(4)
L.	OPR 50(g)(ii)
M.	WLFMR 37(1)
N.	WLFMR 38(1)
O.	WLFMR 38(2)

Act - *Forest Practices Code of British Columbia Act*
OPR - Operational Planning Regulation
THPR - Timber Harvesting Practices Regulation
WLFMR - Woodlot Licence Forest Management Regulation

Note: Amendments to the *Act* and regulations may occur periodically and could result in changes to section numbers listed in the table. In the event of any changes an updated appendix will be made available on the Ministry of Forests guidebook publication website under the heading of "Soil Conservation Guidebook – updates."